

UNIVERSITY OF CAMBRIDGE

Department of History and Philosophy of Science

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THE METAPHYSICS OF SYMMETRY

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The title of the paper can be understood in two senses. Firstly there is the analysis of the concept of symmetry and how the concept gets involved in physics. Secondly there is the point, stressed by Eugene Wigner, that symmetry principles act on a higher or meta level as compared with physical laws.

The changing role of symmetry principles in physics is sketched with historical examples ranging from Anaximander, through Stevinus, Galileo and Fourier, to Einstein and modern particle physics. Two complementary aspects are stressed - symmetries derived from laws, and laws derived from symmetries.

Various types of symmetry principle are distinguished, universal, mathematical, physical, heuristic, accidental, geometrical and dynamical.

The relationship between symmetries of two theories which stand in various relations of correspondence is discussed. This involves developing an appropriate apparatus for representing arbitrary theories, their symmetries and their correspondence relations. A revised formulation of the Curie-Post Principle, which has been proposed to govern symmetry in intertheory relation, is given.

Finally a classification of heuristic symmetries is attempted and the symmetry approach to physics is contrasted with the self-consistency or bootstrap approach.

The paper includes a number of simple examples designed to illustrate the various ideas discussed.